Why Is It So Hard to Tell If Dredging Bothers Winter Flounder (Pseudopleuronectes americanus)?

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What I hope to Do Today

• Introduce the Providence River dredging project.
• Talk about “risk assessment”
• Talk about winter flounder eggs.
• Talk about resuspension in the Providence River
• Put it all together.
Providence River

- Problem: Where to put the dredged material?
- Solution: Dirty stuff in CAD cell, clean stuff goes off-shore.
- “Ecological effects?”
- “No problem!” (ACOE)
- “No dredging in Feb, Mar, and April!” (USFWS, DEM)
- Dredging Sequencing is the answer.
Dredging Sequencing

No dredging Feb 1 - April 30

Dredge any time

Dredge March/April
Why Worry About Winter Flounder?

- The Winter Flounder is recreationally and commercially important.
- Populations have declined steadily over the past 20 years and are at an all time low.
- The species is considered to be overexploited and threatened.
- Winter Flounder eggs are vulnerable to burial from dredging operations.
Why are Winter Flounder eggs Vulnerable to Burial?

- Winter Flounder eggs are vulnerable to burial because:
- Eggs are demersal and stick together in clusters on the substrate surface.
- Spawning occurs in the late winter.
- Hatching takes between 15-18 days at a temperature of 2.8°-3.3°C.
So, What’s the Problem?

• Conventional wisdom is that sediment deposition of ½ of an egg diameter (approx. 0.5 mm) causes a reduction in viable hatch.

• To reduce risk to eggs dredging “sequencing” and/or expensive seasonal constraints on dredging are sometimes employed (e.g.; NY/NJ, Boston, Providence).

• Problem: There are very few data to back up the conventional wisdom.
Dredge Plume  “Apron of Death”
Or “Sediment Blanket”

Channel

Dredge

Flats

Shore
Dredge Plume

Channel

Dredge

Flats

Shore
Dredge Plume Effects on Flounder?

Need to Know:
1) Extent of plume
2) Location of Spawning
3) Exposure-Response

Channel
Dredge
Flats
Shore
Estimate of Risk

Combine: Concentration, Exposure, and Effects
Research Question:

What effect does sediment burial have on the hatching success of winter flounder eggs?
Exposure Beakers for Winter Flounder Burial Experiments

- Water inflow
- Plastic pipette
- Screened outflow
- Notched Test tube
- Aeration
Exposure Beakers
Experimental design for second experiment

(Drawing obviously not to scale)
% Total Hatch vs. Sediment Depth
All Experiments Combined

R² = 0.5693
Cumulative % Total Hatch by Day

Exp 2: % Total Hatch

Sediment Depth
- 0.0 mm
- 0.68 mm
- 1.4 mm
- 2.7 mm
- 5.4 mm
- 11.0 mm
Why is Delayed Hatching a Problem?

• The longer it takes to hatch, the deeper you can get buried.

• Delayed hatching may make juveniles more vulnerable to predation.
  • Warmer winter temperatures lead to lower recruitment.
  • Increased predation has been indicated as a possible cause.
The Flounder and the Shrimp

- In cold years flounder recruit before shrimp become active.
- In warm years the shrimp are waiting when the flounder hit the bottom.
- Any delay of hatching may thus lead to increased predation.
Conclusions: *Laboratory Egg Burial Experiments*

- Winter flounder hatch rate can be reduced by as little as 1.1 mm burial in clean, muddy sediment. All treatments greater than 2.8 mm burial had almost no hatch.
- Winter flounder hatch may be delayed by less than 1.0 mm burial in clean, muddy sediment.
- Delay of hatch may be a problem for winter flounder.
How do you know where winter flounder eggs are?

- Drag bottom with and epibenthic sled and collect eggs.
- Guess (Use info from other estuaries)
- Look for newly-hatched larvae
Providence River

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Dredging Sequencing is the answer.
Circulation patterns in Upper Narragansett Bay

After Kincaid, 2003
Potential low current areas in Narragansett Bay
Hypothetical Deposition of sediment

Deposition (mm)

- 0.0
- 1.0
- 2.0
- 3.0
- Above 3.0
Hypothetical Overlap of Deposition and Eggs

Deposition (mm)

- 0.0
- 1.0
- 2.0
- 3.0
- Above 3.0
What We Still Do Not Know

- Exactly what depth of sediment causes problems for winter flounder.
- Exactly where the flounder spawn.
- What the meaningful deposition rate from dredging is in winter flounder spawning areas.
- What risk that deposition poses to winter flounder eggs.
Any Questions?
Doug’s Device
Hint 1: Doug’s Boat
Doug’s Boat (2)
Doug’s Boat (3)
Field Efforts

Wide Area Tidal Stage
Plume Characterizations
(Transects)

Channel

Dredge

Flounder Egg Arrays

Flats

Shore
Dredging/Disposal Sequencing

Figure 7-2. Potential Dredging Sequences for the Providence River Dredging Project

<table>
<thead>
<tr>
<th>Priority/Constraint</th>
<th>April Start</th>
<th>August Start</th>
<th>September Start</th>
<th>January Start</th>
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<tr>
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<td>Aug Fox Point</td>
<td>Sep Fox Point</td>
<td>Fuller Rock</td>
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